As is usual, once the infection invades the deeper structures, such as the brain and walls of the bloodvessels, it is difficult to eradicate. Even great improvement may follow the use of any of the antisyphilitic remedies, but it is seldom that cure is effected, as shown by the persistence of the Wassermann reaction. Benefit follows even good care and generous diet; greater benefit results from the addition of mercurials, and still greater benefit follows the administration of salvarsan.

This untoward result is probably due to the slight access of the blood-serum to the spirochete, owing to the avascular granulation tissue in which it becomes embedded. Whether resort to repeated courses of salvarsan for a long period may not finally effect a cure by destroying all the spirochetes remains to be proved. There is, however, sufficient evidence to render such a course at least encouraging. The chief difficulty is in getting the patients to submit to the necessarily protracted course of treatment, especially if, as in this woman, they early become restored to a satisfactory feeling of well-being.

THE EARLY DIAGNOSIS OF SPINAL CORD TUMORS.

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We report two cases of extra-medullary tumor of the spinal cord, presenting a so-called atypical symptomatology, and with these cases in mind discuss the early diagnosis of the disease.

Case I.—A Russian Jew, eighteen years old, whose heredity and past history are negative, entered the Neurological Institute October 15, 1913, when the following history was obtained: Up to three months ago he was active and strong on the legs. His parents then noticed that his gait was somewhat unsteady, that he was not walking in a straight line. A month later he began to find it difficult to keep his balance, to climb stairs, and to run. He began to trip and tire easily, and on two or three occasions he fell. These infirmities steadily progressed up to three weeks ago. Since then there has been little or no change. The right leg he believes has been weaker from the start than the left. Otherwise he has had no symptoms, and feels quite well. Regarding sensory disturbance, on direct questioning, he recalls that occasionally he has felt slight drawing sensations in the backs of the thighs on overexertion, but at no time has he had pain, girdle sensation, or other paresthesiae.

He is well developed and nourished. The face has an expression that one associates with existence of adenoids; the tonsils are hypertrophied. The submental and cervical glands are somewhat enlarged, discrete, and hard; the thyroid isthmus is palpable. In the chest and abdomen nothing abnormal can be detected.

His pupils are not quite circular; the left is somewhat greater than the right, but both react well to light and accommodation. The cranial nerves are otherwise quite negative. His upper extremities present no abnormalities. The abdominal muscles function well. He sits up readily from dorsal decubitus without the aid of the arms. The epigastric and abdominal reflexes are lively and about equal. His spinal column shows no deformity, no tenderness and range of movement is quite free in all directions.

Examination of the lower extremities reveals definite alterations. Over both hips there is laterally a little flattening, especially on the right. The buttock and thigh muscles as a whole have a somewhat flabby consistence. A low grade of hypotonia is present in the hamstring groups, particularly the left. Range of motion is normal in all the joints except for dorsiflexion of the right ankle, which is moved upward in moderate valgus position. Despite normal range, however, there is considerable loss of power. Flexion at the thighs is poorly sustained, and only with great effort; adductor power is feeble, abductor power almost nil, the left thigh is weaker than the right. At the knees, both flexors and extensors are somewhat weak, especially the flexor groups. At the ankles, dorsiflexion on the right is feeble, on the left only slightly affected. The plantar flexors are apparently unimpaired. There is some secondary static swaying of the upraised legs, but no dynamic tremor, ataxia, or asynergia. The knee- and ankle-jerks are somewhat exaggerated but equal. On the left there exists typical Babinski and Oppenheim phenomena, and marked ankle-clonus. On the right a rapid extensor response, inconstant Oppenheim, and exhaustible clonus. On standing certain instabilities appear: the trunk twists on the pelvis, the pelvis sways laterally, the legs flex and extend irregularly at the knees. All these movements are of small range, however, and do not materially disturb equilibrium even with feet together. Well-marked Rombergism exists with a predominant tendency to fall to the right. His gait shows no gross impairment; at most it is mildly spastic ataxic. He is able to climb stairs, to run, and to perform other movements calling for strength and coördination.

Sensation. No zone of hypersensibility can be determined. Over each thigh anteriorly is a small indefinite patch of combined hypesthesia and anesthesia, otherwise touch is everywhere intact. A slight grade of hypalgesia starts just beneath the groin, somewhat abruptly on the right, more gradually on the left, and continues (though relatively greater on the right than on the left) without definite alteration anteriorly to the toes. Posteriorly no disturbance can be detected on the right; on the left there is a vague relative hypalgesia from the knee hollow downward. The level and character of thermoesthesia is approximately the same as for pain, namely, the level of the groin or slightly below. On the right extremity anteriorly cold is not perceived and heat is either diminished or not felt. On the left extremity anteriorly the same disturbances are apparent but are less marked. Posteriorly a mild therm-hypesthesia exists right and left from the knee hollows down. There is considerable impairment of postural and passive movement in the toes. Vibration sense is abolished and the Weber circles appear abnormally widened.

The electrical reactions of accessible muscles are normal. The blood and spinal fluid show no abnormality.

The patient remained in the hospital two weeks. During this time a slight improvement was noted. His condition after that, however, grew steadily worse. At first he was able to walk to the dispensary unaided. Soon he had to use a stick, later he could only come when someone supported him; finally he was unable to come at all. By February, 1914, the spasticity of his legs had progressed to such an extent that he could not stand unaided. He described now a feeling of strain on the right side below his umbilicus, a slight drawing sensation about the waist line after sitting for any length of time, and on defecation a sense of internal tenesmus, as if the intestine had not emptied itself. Still there was no actual pain.

Physical examination, February 11, 1914, four months after he was first seen, revealed a marked spastic paraplegia, double Babinski phenomenon, and double clonus. The sensory disturbances had greatly advanced. From the groin downward the whole right leg except for a small patch here and there was anesthetic. Over the left leg, especially along its internal surface, were irregular bands of diminished touch perception. Pain and temperature sensibilities had suffered practically an obsolute loss from just above the knees to the ankles anteriorly; and elsewhere from the level of the groin downward, especially on the right, they were gravely disturbed. Sense of posture and of passive movement was completely abolished in the toes. No areas of hyperesthesia could be determined and the changes from normal to diminished sensation remained much as first described.

The diagnosis of tumor, which had previously been made, was now considered possible, and the patient was urged to submit to operation. On February 14, 1914, laminectomy was performed by Dr. Elsberg. Removal of the spines and laminæ of the ninth, tenth, and eleventh dorsal vertebræ. To the right of the tenth dorsal lamina, dorsolateral to the cord, was seen a bluish mass, over the lower part of which a nerve root was stretched. After considerable bone had been rongeured away a soft extradural bluish tumor, about 4 cm. in length, was exposed. The nerve root, posterior dorsal eleventh, which ran over the tumor, was divided. The tumor was freed and removed. It was 4 cm. long, about 1 cm. thick, and on section was fibrous, containing spicules of bone. On microscopic examination it proved to be a fibroma with calcareous degeneration.

Almost at once the patient began to improve. A month after the operation, though still weak, he was walking short distances without assistance. On April 17, 1914, he showed the following condition: the right epigastric reflex is lively, the left present, the abdominals are feeble right and left; range of movement at all the joints is normal. At the hips flexor power is excellent; adductor fair; abductor still rather feeble. At the knees and ankles no definite impairment can be detected. There is possibly still a slight increase of tone on the right, but this is all that remains of his marked spasticity. The knee- and ankle-jerks are on the lively side and equal. Double Babinski and clonus still persist. His gait is somewhat shambling and slightly spastic, but he can walk a mile or more without fatigue. He mounts stairs and stands on one leg without difficulty. The superficial sensory disturbances of the legs have totally disappeared. There is still some loss of posture sensibility and of passive movement sensibility in the toes, however, and Rombergism still persists.

Case II.—A Russian girl, aged fifteen years. Heredity and past history negative. At the age of eleven she began to feel sharp twinges of pain over the precordia, at first daily, then at gradually lengthening intervals up to six or seven months apart. The pain was never severe or radiating, but was localized beneath the breast. A so-called attack would consist of but a single twinge or catch and no more, of a moment's duration. She was believed to have heart disease. At the age of fourteen years she went to work as an errand girl. After about nine months she began to feel tired in her legs at night. Three months later she began to drag her right foot. She was told at a hospital that she was suffering from flat-foot. About six weeks later she was dragging her left foot. At the same time she began to complain of a slight sense of heaviness beneath the left costal margin, relieved by pressure, and of hurried action of the bladder with occasional incontinence. At this time she entered the Neurological Institute July 20, 1911, when the following note was made: The patient is well developed and nourished. The cranial nerves and upper extremities are quite negative. The epigastric reflexes are present equal but sluggish, the abdominal not obtainable. In the lower extremities no atrophy can be determined. Both legs are somewhat hypertonic, amounting to slight spasticity on the right. The knee- and ankle-jerks are equal and greatly exaggerated. Double

Babinski and ankle clonus exist, the latter exhaustible on the left. She stands insecurely with feet together, the right leg being very weak. Her gait is that of double foot-drop with spasticity. The right leg, which is much more profoundly affected than the left, she swings outward very much as does a hemiplegic. Over both legs, especially along the outer surfaces, are patches of hypesthesia and anesthesia for all sensory qualities. There is some blunting of posture and passive movement of the toes. No zone of hyperesthesia can be determined. Electrical examination is negative.

The patient's condition went steadily from bad to worse. The following is extracted from a note made six weeks after her admission: She is now wholly unable to stand or walk. Marked spasticity appears in the legs on attempts at active and passive motion. In dorsal decubitus the feet are in typical pes cavus posture. The peroneal muscles are wholly inactive, producing double foot-drop with inward inclination. Active movement at the ankles is totally abolished. The thighs are thin and the muscles of the right side have the appearance of being slightly atrophic. The lower legs are so thin that they can be spanned with the hand. All the tendon jerks are exaggerated, and there is continuous patella and ankle clonus. Double Babinski is likewise present. Deep sensibility of the lower extremities is profoundly impaired. She has no idea of the position of her feet and legs. Loss of tactile sensibility is very indefinite both in quality and distribution. Over certain portions of the lower extremities she feels the cotton wool with some distinctness; over other areas she does not recognize it. Tactile sensibility becomes acute on the left side posteriorly after the iliac crest is passed. On the right side it does not become acute until the border of the ribs is reached. Anteriorly right and left it first becomes normal at the level of the umbilicus. Pain sensibility does not seem to be particularly obtunded. Temperature disturbance has much the same disturbance as tactile, and consists of reduction, confusion, and absolute loss. Above the umbilicus mistakes are few.

The patient remained at the Neurological Institute seven weeks, then entered the Hospital for Ruptured and Crippled. Here she gradually improved. At the end of seven months, with the aid of braces and crutches, she could walk about a block. A month later approximately she threw one crutch aside. Four weeks later the braces were removed from the left leg and she discovered she could bend the knee almost normally. Soon afterward she was able to walk one or two steps without crutches. After about a month of steady improvement her legs began to gradually weaken, until in May, 1913, a condition of complete paraplegia had been reached again.

Physical examination revealed a condition somewhat similar to that noted when she left the Neurological Institute, except that it was more pronounced. In contrast to the marked objective disturbance, especially on the motor side, her only subjective sensory complaint has been and was the mild feeling of heaviness beneath the left costal border. The slight twinges of precordial pain had ceased eighteen months before.

Operation, May 22, 1913, at the Hospital for Ruptured and Crippled, by Dr. Alfred S. Taylor, Associate Surgeon to the Neurological Institute. Right unilateral laminectomy, from dorsal third to dorsal seventh inclusive disclosed an extradural cyst lying under the dorsal third, fourth, fifth, and sixth laminæ, mostly to the right of the median line and dorsally. Two projections from the main cyst reached over to the left of the median line dorsally. The cyst was loosely adherent to the dura and was attached to the bone by thin fibrous tissue, above and below. The cord beneath showed no other change than that due to prolonged pressure. Wound closed without drainage by layer sutures. Primary union.

Two weeks after the operation she began to move her toes. A week later she could flex and extend her knees. Seven weeks after the operation, with the aid of crutches, she was walking from one end of the ward to the other. At the end of July, 1913, she discontinued using crutches. For the past eight months she has felt no functional disability whatever.

At present the patient goes to school. She walks a mile or so a day and never has felt stronger or healthier. Physical examination shows a slight general atrophy of the right thigh. The epigastric and abdominal reflexes are active and equal. Range of motion is normal at all the joints, muscular power excellent, tone without defect. The knee, patella, and ankle-jerks are active but not exaggerated, and are equal right and left. Plantar stimulation gives a normal response. Clonus is absent. She walks and runs, stands on one leg, and can mount two stairs at a time in perfect fashion. Superficial sensibility shows no defect except possibly a slight tactile blunting over the dorsum of the right foot. Deep for sensibility is quite intact.

THE EARLY DIAGNOSIS OF TUMORS WITHIN THE SPINE. A consideration of these cases naturally raises the question of the early diagnosis of cord tumors. Up to comparatively recently a classical unfolding of symptoms was generally demanded before a diagnosis was ventured. In particular great stress was placed upon the sensory irritative phenomena of the so-called initial or radicular stage. Above all the cardinal significance of pain as an early symptom was strongly emphasized (Bruns, Oppenheim, Flatau, and others). Gradually, however, reports began to creep into the literature of extra-medullary spinal growths running their course with minor sensory phenomena, with slight pain or absent throughout. In other words it was shown that the preliminary or root stage might be insignificant or totally wanting.

The two cases here reported belong to this group. In Case I pain was absent; in Case II it was slight and atypical. Other subjective sensory disturbances played an extremely minor role. In both cases the onset and march of symptoms were essentially motor. The symptoms commonly regarded as cardinal for the early recognition of spinal cord tumors were lacking.

It is upon this point that we wish to lay particular emphasis. The absence of pain and paresthesias is not a rare or exceptional phenomenon in extramedullary tumors. Nothing is more fallacious than the belief that pain is a necessary symptom. The steadily growing literature of so-called atypical cases convinces us that classical criteria for early diagnosis must fall away and new ones must be established.

In 1902 Oppenheim[1] wrote: The absence of pain in spinal cord tumors is extremely rare, and he mentioned the observations of Clark, Bailey[2] and Sibelius.[3] In 1906 Flatau and Sterling[4] reported a case, with slight abdominal pain, and referred to a case of Jaffe and two of Schultze, the only additional ones they were able to collect. Since then, thanks to our keener conception of the disease, the literature has been growing rapidly. With no attempt to exhaust the list we may mention the names of Nonne,[5] Oppenheim,[6] Oppenheim-Cassirer, Bing and Bircher,[7] Flatau,[8] Stursberg,[9] Panski,[10] Sanger,[11] Thomayer,[12] Trömmer,[13] Schultze,[14] Bregman, Sailer,[15] Joachim,[16] Boettiger,[17] E. Müller and Heilbronner,[18] all of whom have contributed one or more cases. And if our diagnoses past and present were put to the crucial test, how few of us would not be involuntary contributors? Not many of us probably would escape the experience of Nonne,[19] who diagnosed a myelitis because of the complete absence of pain, and found at autopsy a cyst reaching from the seventh to the tenth dorsal roots. Pain is a valuable symptom when present, but it is frequently absent, and, as Stursberg,[20] insists, should never weaken the suspicion of tumor, provided other diagnostic conditions are fulfilled.

Just as the complete absence of pain must be recognized if an early diagnosis is to be reached, so it must also be recognized that

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[1] Lehrbuch der Nervenkrankheiten, 1902, 3d edit.
[2] Jour. Nervous and Ment. Dis., 1896, xxii, p. 171.
[3] Jahresbericht auf dem gebiete der Neurologie und Psychiatrie, 1899, p. 686.
[4] Deutsche Zeitschrift Nervenheilk., 1906, xxxi, p. 199-223.
[5] Neurologisches Centralblatt, 1908, p. 749.
[6] Münch. med. Woch., 1906, No. 46, p. 2272.
[7] Deutsch. Zeitschr. f. Chirugie, 1909, xcviii, p. 258-76.
[8] Lewandowsky Handbuch der Nuerologie.
[9] Deutsch. Zeitschr. f. Nervenheilk., 1906-07, xxxii, p. 113.
[10] Neurologisches Centralb., 1912, xxxi.
[11] Ibid., 1908, p. 795.
[12] Ibid., (Ref.), 1908, No. 2, p. 80.
[13] Ibid., 1908.
[14] Mitteil. aus dem Grenzgeb. der Med. und Chir., 1903, xii, p. 153.
[15] Centralb. f. Nervenheilk., 1901, p. 111.
[16] Deutsch. Archiv. f. klin. Med., 1905-6, No. 86.
[17] Archiv. f. Psychiatrie, 1901, xxxv, 83-108.
[18] Deutsch. Zeitschr. f. Nervenheilk., 1908, xxxiv, p. 289-303.
[19] Loc. cit.
[20] Centralbl. f. das Grenzgeb. der Med. und Chir., 1908, xi, p. 91.

pain when present may present little or nothing characteristic. The neuralgic character may be entirely lacking. The pain instead of being radicular may be of a centrifugal type, appearing in parts of the body far removed from the segmental localization of the tumor. In one of Flatau's,[21] cases (tumor in the eighth cervical, first dorsal region) pain first appeared in the left foot. In a case reported by Ramson-Thompson[22] (extradural sarcoma in the region of the eighth cervical to twelfth dorsal roots), pain not only appeared in the epigastrium but in the lower dorsal vertebra and legs as well. Abrahamson reports a case of tumor at the eighth cervical level in which the first sensory symptoms consisted of paresthesias of the legs; Oppenheim and Heilbronner, tumors in the mid-dorsal region, likewise with pain confined chiefly to the lower extremities; Henschen a case of tumor at the level of the cervical segments with girdle sensation in the lower abdomen. In one of our own cases (H. A., 3181), after a progressive spastic paraplegia of three years' duration, the patient developed a girdle sensation in the lower abdomen. This disappeared and was followed a year later by girdle sensation in the upper abdomen. Approximately five years after the onset of symptoms the patient began to experience his first real pains, boring pains which started in the dorsum of the feet and thence shot upward to the thighs and hip-joints. Laminectomy revealed an extradural tumor at the level of the sixth dorsal vertebra. Not only do pains radiate downward, they may also radiate upward above the tumor, as is shown by observations of Oppenheim and Flatau,[23] tumors in the dorsal and lower cervical cord respectively, in which pain was felt in the neck and occiput. We also have a case to add to this group.

Pains may be referred to various viscera and lead to mistaken diagnoses. In Collins[24] and Quante's cases the patients were believed to have appendicitis; Fränkel's patient had his appendix removed; Schultze's case was treated for gall-stone colic and Starr's for angina pectoris; Case II, above reported, was believed to have had heart disease; one of Putnam's cases was treated for indigestion. Abdominal pain is not at all infrequent, as Oppenheim's[25] series teaches, and as one of us has pointed out, is all the more readily mistaken for some visceral disease because of its apparent relationship to eating, flatutency, and constipation.

Pain is not only inconstant and frequently atypical, confusing or masking the picture in its referred form, without segmental localizing significance in its centrifugal form, but it loses further in value as a differential diagnostic symptom between extra- and intramedullary growths. Not a few cases of intramedullary tumor have already been reported running a course with more or less marked pain. A striking contrast is offered by Thomayer[26] in two cases—one of an extradural tumor producing a syringomyelic dissociation with complete absence of pain, the other an intramedullary tumor accompanied by pain and complete anesthesia. Other characteristic qualities also fall away. In both intra- and extramedullary tumors as well as vertebral, variations in pain may occur with different body postures (Bregman,[27] Michaels). Sensitiveness to pressure may be present in extramedullary growths as well as vertebral (Schultze,[28] 4 cases), and in both pain may be aggravated by coughing, sneezing, laughing, etc.

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[21] Loc. cit.

[22] British Med. Jour., 1894.

[23] Loc. cit.

[24] Medical Record, 1902, lxii, pp. 882-94.

[25] Deutsch. Zeitschr. f. Nervenheilk., 1903, xxiv.

Inconstant are also the hyperesthesias, the paresthesias, and the subjective and objective radicular zones. The first manifestations of tumor may be and are frequently medullary. Far from being an early symptom the constrictive band may first be felt months after the motor display is well advanced: in 1 of our cases two years from onset and in another three years later. In 9 cases of dorsal tumor in our series, verified by operation, the constrictive band was typical in only 2 cases, in a third vague, in the remaining 6 cases entirely absent. In 2 cases of cervical tumor it was likewise lacking. The duration of these cases up to time of operation varied roughly between one and eight years. In 15 cases of verified tumor, hyperesthesia was present in only 6 cases, in 2 of these appearing as ill-defined areas, namely, in the foot and over the sacrum; in the remaining 4 as the typical zonal bands. Furthermore, we have been unable to establish any constant relationship between girdle sensation and objective findings. In only 1 of our 15 cases in fact, were both simultaneously and typically present.

What has just been said for irritative root phenomena applies also to paralytic root signs, which when present appear, as a rule, much later. Pure root anesthesias are uncommon. When present they usually soon merge into medullary sensory disturbance. For a radicular anesthesia to be well defined at least three roots must suffer considerable damage. The uncertainty of this sign for early diagnosis is therefore apparent. It has been conclusively shown that a single sensory root or even a motor root may be completely destroyed by an extramedullary tumor without the slightest radicular sensory defect on the one hand or definite paralysis on the other (Bruns[29]).

A word concerning medullary sensory disturbance: It may mask or precede the radicular phenomena; it may be dissociated as in syringomyelia (Thomayer, Devic-Tulot,[30] Putnam-Warren[31]); it may be slight or patchy with irregular distribution, it may vary from day to day or may appear in regions far removed from the site of the tumor, as in the case of Roux Paviot, where a tumor in the cervical dorsal region produced anesthesia of the soles of the feet. Finally, as one of our own cases illustrates, bony exostosis of the three upper dorsal vertebræ with pressure on the cord and thickening of the membranes—despite complete paraplegia of seven years' duration—sensation may remain quite intact.

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[26] Neurologisches Centralbl., 1908.

[27] Zeitschr. f. Nervenheilk., 1906, xxxi, p. 68.

[28] Loc. cit.

[29] Geschwülste des Nervensystems, p. 347.

[30] Revue de Med., 1906, No. 3.

[31] Amer. Jour. Med. Sci., 1899, p. 377.

THE CRITERIA FOR EARLY DIAGNOSIS. What then should be our basis for the early recognition of cord tumors? First of all we must realize that pain and other classical data are valuable but not essential phenomena, but that the essential element in the diagnosis (first emphasized by Schultze[32]) is the determination of a gradually progressive motor and sensory spinal paralysis, the upper pole of which, despite increase in cross-section intensity, varies slightly if at all. In every case of so-called transverse myelitis, therefore, the possibility of cord tumor should be considered. This applies to acute forms of myelitis of obscure origin as well. Flatau,[33] for example, reports a case in which after a short illness sudden paralysis of the legs appeared; Bregman and Steinhaus,[34] the sudden development of a complete paraplegia within forty-eight hours. Not only this, but the acute cross-section paralysis may be ushered in and accompanied by fever, making the resemblance to an acute infectious myelitis even more disconcerting. Cases of this sort have been studied by Panski and Bregman.[35]

There is only one moral to be drawn. The diagnosis of myelitis of unknown origin is made far too often; exploratory leminectomy is not done often enough. In all doubtful cases we are not only justified, but, it seems to us, in duty bound to the patient to give him this chance. The danger of the operation stands in no relationship to the certainty with which he will otherwise succumb.

The force of these statements is emphasized by the two cases reported above. Case II may be regarded as completely cured; Case I is rapidly improving and will probably terminate in complete or nearly complete functional recovery. Both, from a diagnosis point of view, are so-called atypical cases.

We urge that the term atypical be discarded from the symptomatology of cord tumors. Painlessly advancing tumors are not atypical. They form a definite and important group more significant because less tangible than the classical series. Unless this is generally recognized, unfortunately it must usually be brought home by bitter experience—we shall continue to make serious errors in diagnosis. It is to be hoped that the day is not far distant when exploratory laminectomy will be undertaken with the same freedom as exploratory laparotomy. The risk under proper conditions is not great and the results are among the few happy ones in organic diseases of the cord.

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[32] Loc. cit.

[33] Cited by Panski.

[34] Medycyna, 1902, 25-28.

[35] Ibid., 1905, 23-27.